WildPackets®
Illuminate Your Network™

A Guide to Troubleshooting User Satisfaction Problems with SAP Applications

WHITE PAPER

Is It the Application or the Network?

If you're a network engineer in an organization that runs SAP, you're probably familiar with the challenge of troubleshooting SAP networking problems.

A typical scenario goes like this. End users of a SAP application complain about poor application performance. The SAP BASIS Administrator and Database Administrator report that the SAP applications themselves are performing correctly. They suggest that the real problem lies with the network. They ask you to troubleshoot the problem.

But is the network really the problem? How can you tell? Without in-depth SAP expertise and tools, how can you accurately diagnose a SAP application performance problem?

This problem isn't confined to SAP applications. Whether the application is SAP, Oracle, VoIP, or some other type of application, it's often difficult to determine whether the application or the network is ultimately responsible for poor quality of service. Even seemingly straightforward metrics such as server response times can be deceptive. In the context of user tasks and application transactions, a slow server may not turn out to be the critical factor affecting a user's experience.

So, if you cannot rely on simple metrics like server response times, how can you accurately measure how well an application is performing for its users? And if an application's performance is unacceptable, how can you quickly determine the root cause?

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A Guide to Troubleshooting User Satisfaction Problems with SAP Applications

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Measuring End User Experience with the Apdex Standard

Introducing Apdex

A new application performance metric, Apdex, was created by an industry consortium, the Apdex Alliance, specifically to address the challenge of analyzing application performance in meaningful terms. The goal of the Apdex metric is to provide a single metric that represents the quality of service an end user is receiving from an application. Unlike other low-level metrics such as server response times, the Apdex metric:

- Measures performance in the context of a user doing meaningful work
- Bases qualitative judgements on laboratory results of end user experience to judge when users are likely to be content or frustrated
- Provides a single, high-level metric that reflects the quality of service an application is delivering, based on multiple samples of tasks

Apdex scores reflect user satisfaction with the performance of enterprise applications.

How does Apdex work? Apdex measures how long it takes users to perform a task, such as completing a Web transaction; each task may comprise several conversations with a server or servers. If a task takes too long to complete, users become frustrated.

Apdex takes several samples measuring the total time required for the completion of a task. It then applies a formula, using a threshold based on user satisfaction levels observed in laboratory testing, and produces a single metric, a number between 0 and 1 that grades the quality of service an application is providing. Scores between 0.94 and 1.0 are excellent. Scores between 0.85 and 0.94 are good. Scores between 0.70 and 0.85 are fair. Scores below 0.70 are poor or unacceptable.

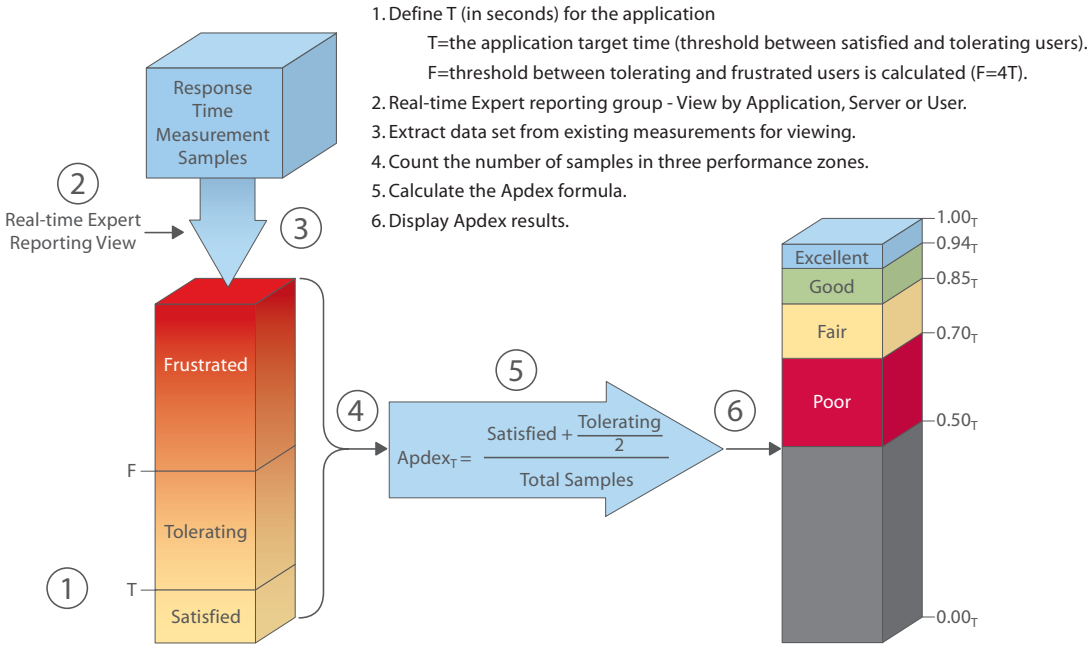

Figure 1: Calculating Apdex Scores

Using these scores, a network administrator can tell at a glance what sort of service an application is delivering. If an application's score is 0.85 or higher, users are almost certainly satisfied with the performance of the application. Lower scores suggest there could be a problem.

Ultimately, Apdex scores reflect the effectiveness of IT investments in contributing to business objectives. If an organization successfully invests in its IT infrastructure, its Apdex scores should improve. Declining Apdex scores are a sign that the IT infrastructure is not serving its business goals.

The Apdex Technical Specification and other information are available at www.apdex.org, the Web site of the Apdex Alliance. The Apdex Standard is part of the IEEE-ISTO.

Apdex and SAP

How do Apdex scores help you troubleshoot SAP applications?

Because Apdex scores summarize application performance results in the context of user tasks, Apdex scores provide a useful diagnostic for determining whether or not a problem exists.

Furthermore, by measuring Apdex scores with a comprehensive network analysis platform, you gain the ability to determine what network or application conditions are contributing to a poor network score. You gain the ability to drill down into the technical details of a problem, starting with the score itself.

But before we explore this rapid drill-down methodology, let's take a quick look at the SAP application architecture. Understanding SAP transactions will help you make the most of Apdex measurements of SAP applications.

Introduction to SAP R/3 and mySAP for Network Administrators

The following illustration shows a simplified view of the architecture of a typical SAP environment, consisting of a Presentation Server, a SAP Application Server, and a Database Server.

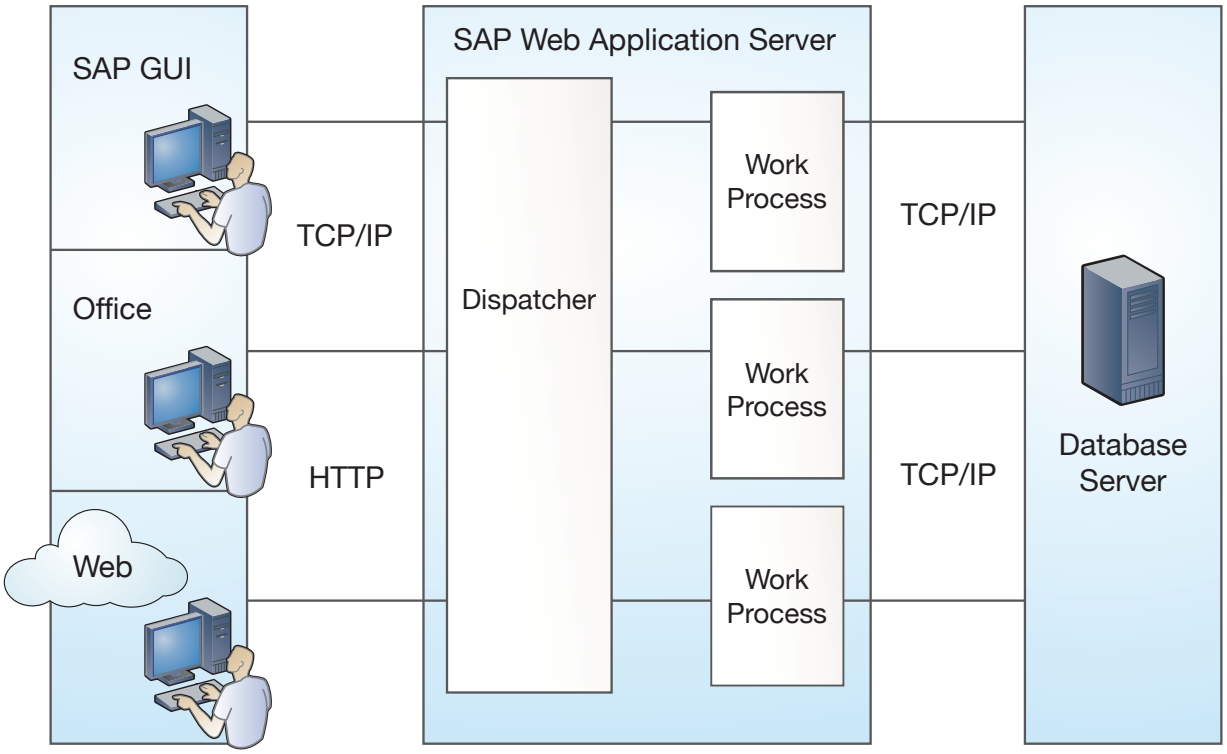

Figure 2. A High-Level View of a SAP Environment

Anatomy of a SAP Transaction

The workflow of a SAP transaction is a multi-step process involving a tiered hierarchy of servers and control points. The workflow is as follows:

- The user enters input through the SAP GUI or a Web browser. The input may be either information to be written into a database, or a request for information or a calculation.
- The input goes over the network via TCP/IP to the SAP Application Server and is handled by the SAP Dispatcher, a software component that functions as a central control unit within a SAP Process.
- Within each SAP Application Server there is a single SAP Dispatcher, which handles all user requests, as well as requests from other SAP Applications Servers. The Dispatcher assigns requests to different Work Processes.
- Each Work Process opens an individual dialog to the required database.
- Responses from the Work Process return by the same path: through the Dispatcher of the SAP Application Server and back to the user.

Most generic SAP implementations have numerous application servers, but for every individual application, there is a single central management point that handles all the communication flows from the SAP GUI or the mySAP Web portal. This single point or gateway will prove useful when it comes to capturing full-duplex traffic and examining average Application Response Times—which in turn is the basis for Performance Monitoring.

Measuring SAP Application Performance and Generating Apdex Scores

Requirements for a Network Troubleshooting Solution for SAP

We've seen that Apdex provides a meaningful metric for assessing how network and application conditions are contributing to an end user's experience. We've also examined the structure of SAP transactions in order to find a focal point for collecting data for monitoring and troubleshooting SAP application performance.

Ideally, network administrators would be able to monitor Apdex scores to look for problem flows from specific applications. Then, once a problematic flow is discovered, network administrators need a way to troubleshoot that flow. As always, it would be nice not to have to change tools in this process. Network administrators should be able to easily navigate between Apdex scores and expert diagnoses and packet details of the traffic contributing to these scores.

All of these capabilities are available in OmniPeek, an enterprise-class network troubleshooting solution from WildPackets.

The WildPackets OmniPeek Product Family

The OmniPeek Product Family gives network engineers real-time visibility into every part of the network – simultaneously from a single interface – including Gigabit, 10GbE, Ethernet, 802.11 wireless, VoIP, and WAN links to remote offices. Using OmniPeek's local capture capabilities, centralized console, distributed engines, and expert analysis, engineers can rapidly troubleshoot faults and fix problems, restoring essential services and maximizing network uptime and user satisfaction.

The OmniPeek Product Family comprises OmniPeek network analyzers and consoles, as well as distributed OmniEngines, which analyze data at remote locations on the network. With its open APIs and a growing family of plug-ins, OmniPeek is uniquely designed to meet the ever-changing needs of network engineers responsible for wired and wireless networks and applications such as VoIP, Video over IP and VoWiFi.

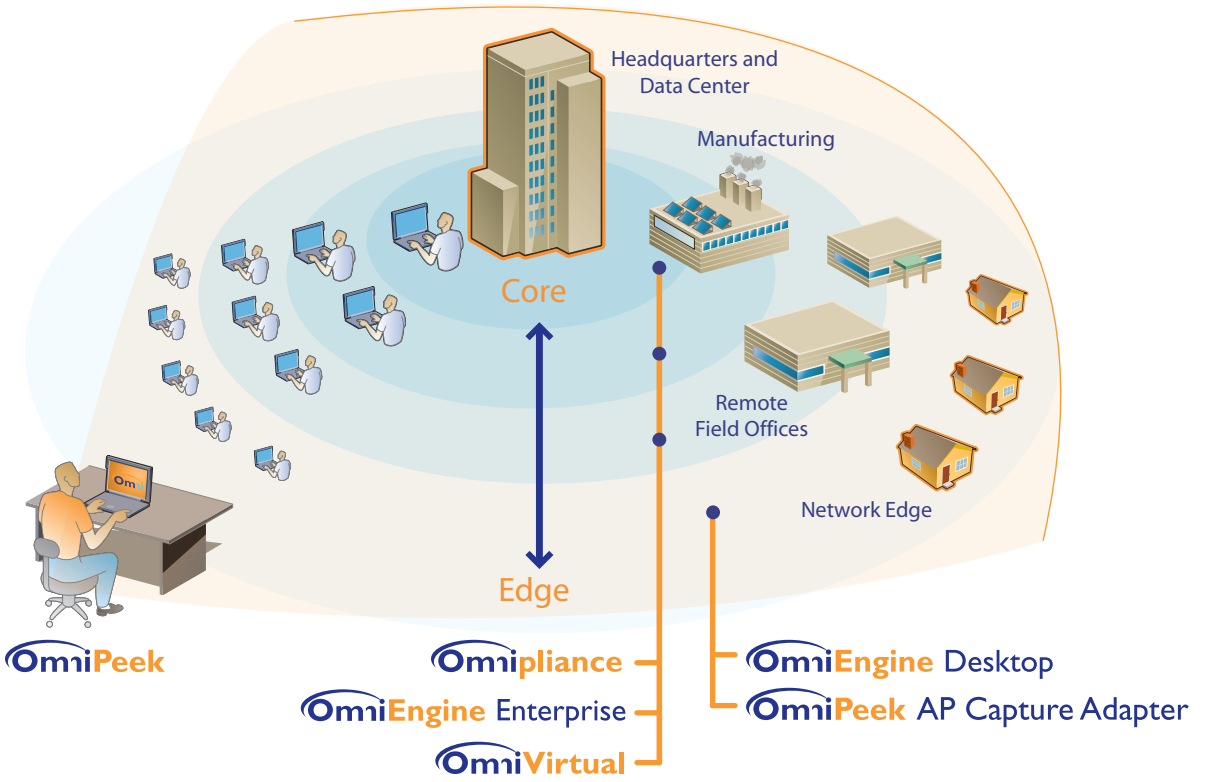

Figure 3: The WildPackets OmniPeek Product Family

OmniPeek is built upon an agent/console concept. The console is the OmniPeek network analyzer, a Windows-based application that presents detailed expert analysis and graphs of network traffic, and provides an interface for working with agents. The agents, which are called OmniEngines, run on either Windows or Linux platforms and capture traffic for local analysis, which is presented in real time through the OmniPeek console. OmniEngines access the traffic on your network either through a SPAN/mirror port on a switch or via a physical network tap. OmniEngines can capture and monitor traffic from Ethernet, full-duplex Gigabit Ethernet, 10 Gigabit Ethernet, and 802.11 wireless segments. (This is a summary of agents and console. OmniPeek also includes other optional components, such as wireless sensors and plug-ins.)

Like the mySAP Platform, OmniPeek processes and delivers all its information in real time. And like mySAP, the product is very extensible. In fact, OmniPeek has its own community of developers using open APIs, scripting language, and decoders to develop new plug-ins and decodes that extend or customize the functionality of the platform. (For more information about this community, please visit the Web site of the WildPackets Developer Network, wpdn.wildpackets.com.)

Unlike competing performance monitoring tools, OmniPeek gains its information independently by passively collecting data from your network and analyzing it over the entire seven OSI Layers – every bit of every packet is analyzed. This is sometimes referred to as "deep packet inspection."

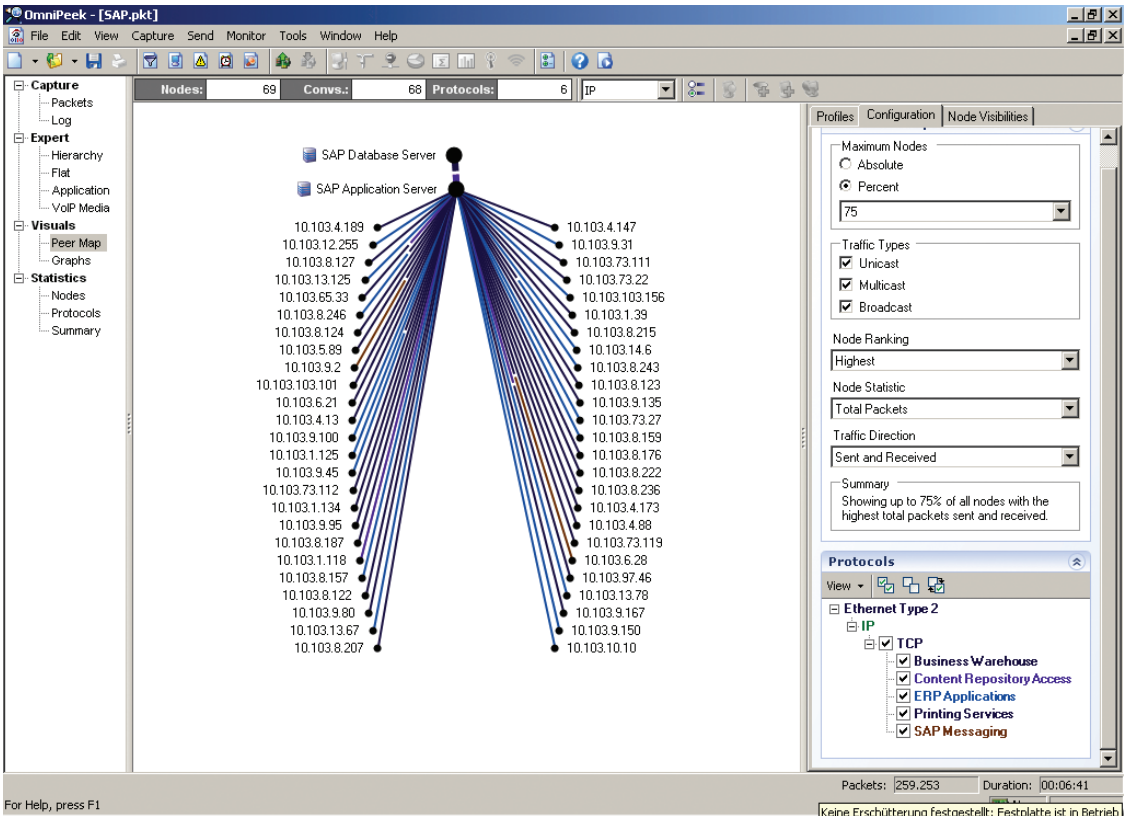

Figure 4: The OmniPeek Peer Map provides a graphical representation of traffic of the network

OmniPeek is able to calculate the actual Application Response Time (ART) when it captures traffic from a TCP/IP Flow. Rather than measure only the TCP ACK response time like many others do, OmniPeek measures the actual transaction time for a GET request, an SQL query, a file open, and so forth.

How can OmniPeek measure and monitor the performance and availability of your SAP Services?

Measuring SAP Application Performance with OmniPeek

Browser-based applications, such as SAP applications, may involve multiple flows—not just flows between the front-end and the back-end application and database servers, but also parallel flows within the client application itself. From click to completion is considered to be an end-user task. These task times, which provide the basis for Apdex scores, fall into three performance zones, or levels of satisfaction, for a task defined by Apdex.

Satisfied User	Tolerating User	Frustrated User
User can focus on a task; progress is not hindered	User notices slowdown; productivity is impaired	User is so unhappy with the poor responsiveness of the application, he or she may stop work on the task

Typically, SAP users consider one second to be a satisfactory average load time, plus or minus some fractions of a second, depending on the actual application. OmniPeek allows you to specify a satisfactory load time as a threshold. By Apdex convention, the tolerating time is 4 times the satisfactory threshold. Thus, if our target satisfactory threshold is 1.5 seconds, then 4 x 1.5 or 6 seconds will be set as the tolerating threshold and anything greater than 6 seconds or abandoned altogether is considered frustrating.

Apdex is a statistical measurement. Several samples are required for accurate interpretation of the Apdex index.

As packets are captured and analyzed, the OmniPeek console displays and updates both the Apdex index and the number of available samples in real time. Additionally, previously captured traces can also be loaded for detailed post analysis for troubleshooting.

The computed index and number of samples are represented in the Expert Application window in the columns labelled "Apdex" and "Apdex Sample Count" respectively. Samples are tallied and fed into a formula to produce the Apdex value.

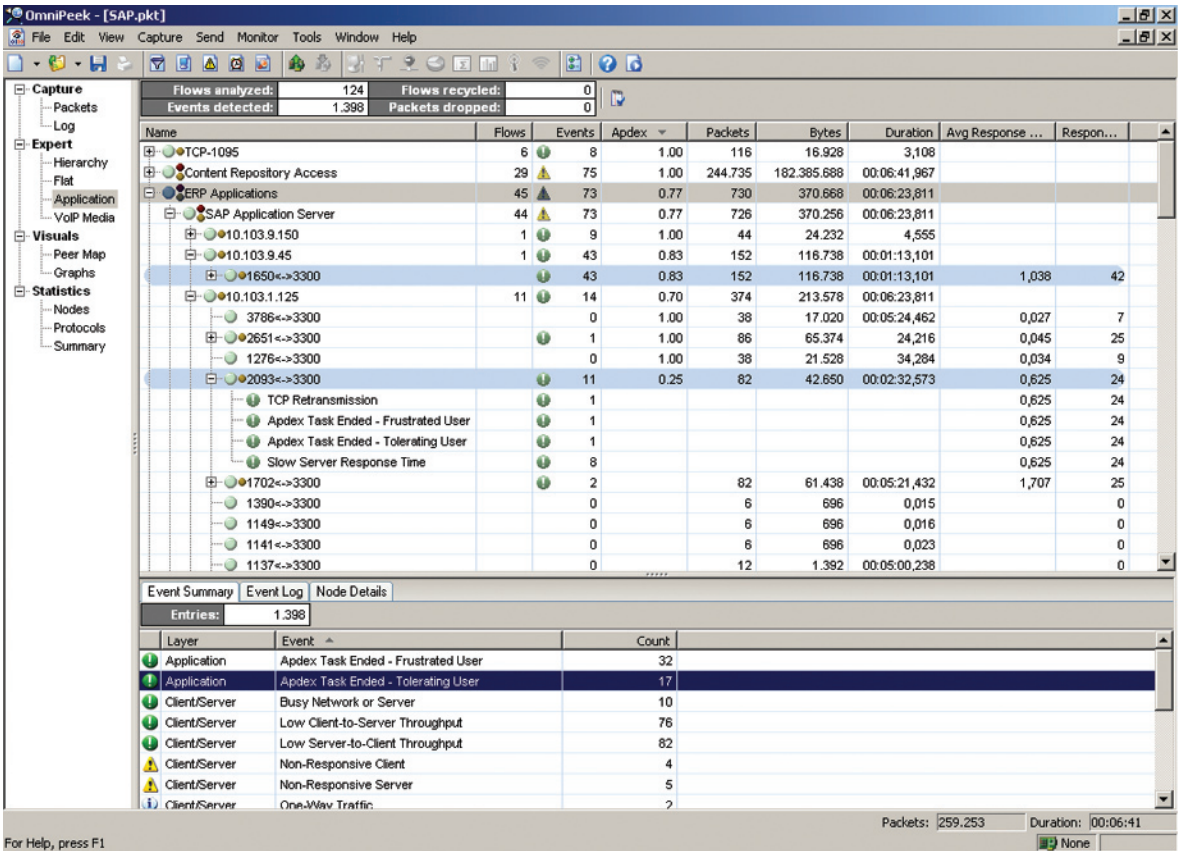
OmniPeek - [SAP.pkt]
File Edit View Capture Send Monitor Tools Window Help
Capture
Packets
Log
Expert
Hierarchy
Flat
Application
VoIP Media
Visuals
Peer Map
Graphs
Statistics
Nodes
Protocols
Summary
Flows analyzed: 124
Flows recycled: 0
Events detected: 1,398
Packets dropped: 0
Name | Flows | Events | Apdex | Packets | Bytes | Duration | Avg Response ... | Respon...
TCP-1095 6 8 1.00 116 16.928 3,108
Content Repository Access 29 75 1.00 244.735 182.385.688 00:06:41,967
ERP Applications 45 73 0.77 730 370.668 00:06:23,811
SAP Application Server 44 73 0.77 726 370.256 00:06:23,811
10.103.9.150 1 9 1.00 44 24.232 4,555
10.103.9.45 1 43 0.83 152 116.738 00:01:13,101
1650<->3300 43 0.83 152 116.738 00:01:13,101 1,038 42
10.103.1.125 11 14 0.70 374 213.578 00:06:23,811
3786<->3300 0 1.00 38 17.020 00:05:24,462 0,027 7
2651<->3300 1 1.00 86 65.374 24,216 0,045 25
1276<->3300 0 1.00 38 21.528 34,284 0,034 9
2093<->3300 11 0.25 82 42.650 00:02:32,573 0,625 24
TCP Retransmission 1 0,625 24
Apdex Task Ended - Frustrated User 1 0,625 24
Apdex Task Ended - Tolerating User 1 0,625 24
Slow Server Response Time 8 0,625 24
1702<->3300 2 82 61.438 00:05:21,432 1,707 25
1390<->3300 0 6 696 0,015 0
1149<->3300 0 6 696 0,016 0
1141<->3300 0 6 696 0,023 0
1137<->3300 0 12 1.392 00:05:00,238 0
Event Summary Event Log Node Details
Entries: 1,398
Layer | Event | Count
Application Apdex Task Ended - Frustrated User 32
Application Apdex Task Ended - Tolerating User 17
Client/Server Busy Network or Server 10
Client/Server Low Client-to-Server Throughput 76
Client/Server Low Server-to-Client Throughput 82
Client/Server Non-Responsive Client 4
Client/Server Non-Responsive Server 5
Client/Server One-Way Traffic 2
Packets: 259.253 Duration: 00:06:41
For Help, press F1
None

Figure 5. OmniPeek shows an Application Performance Index for each individual Communication Flow as well as the total

The screenshot above displays Apdex Values for Enterprise Resource Planning (ERP) Applications in general as well as conversation flows from the SAP Application Server to the individual clients. By clicking on the Expert Event, a network engineer can display all the flows affected by that event.

The Apdex formula is simple but unique. Unlike other performance metrics, it provides a uniform index that represents the satisfaction level and productivity of humans with your SAP applications. OmniPeek does all the hard work in gathering the measurements necessary to produce the Apdex index and to generate individual Expert event notifications that help pinpoint the cause of poor application performance. The Apdex index and supporting data provided by OmniPeek is invaluable on a daily basis as we monitor networks, servers, applications and users.

Apdex Values, the Physical Point of Measurement, and Troubleshooting

Monitoring SAP Servers on an Enterprise Network

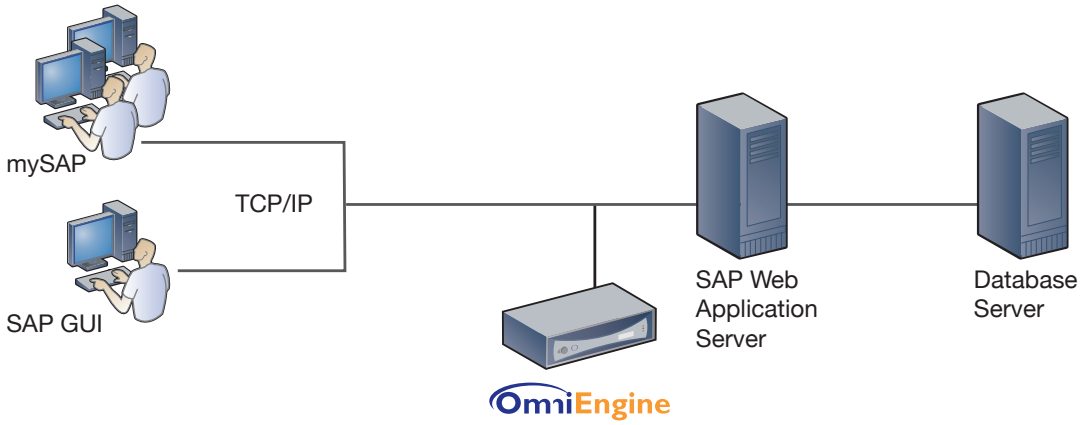

Figure 6. Monitoring a SAP Server on an Enterprise Network

In order for OmniPeek to calculate an Apdex score for an application, it needs to capture the full-duplex traffic of a communication flow. If the flow is captured in front of a client in a switched network, the resulting Apdex score will reflect the quality of service being delivered just to that client. A better location for the capture is in front of the SAP Application Server itself, so that the platform can generate Apdex scores for all the clients communicating with the SAP server.

WildPackets recommends installing an OmniEngine on the network in front of the SAP Application Server. Capturing traffic here, the OmniEngine can track individual scores for each client, as well as an aggregate score for the server overall.

Incidentally, WildPackets recommends not installing an OmniEngine on the SAP Application Server itself, since the OmniEngine's own processing requires some computing resources and may compromise the performance of the server being monitored.

Monitoring SAP Services Hosted Off-site

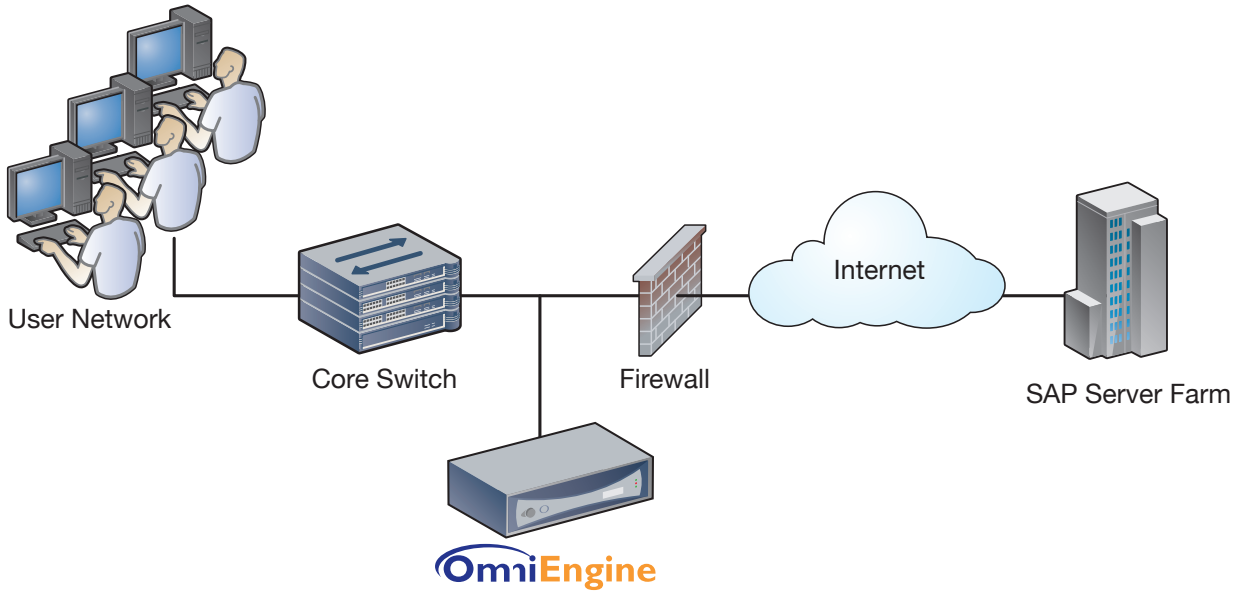

Figure 7. Monitoring SAP Performance of Off-Site Hosted Servers

If an organization is accessing SAP services through an off-site managed service, the OmniEngine should be placed between the core switch and the firewall, so the engine can capture all the flows between the SAP server farm and the SAP user community working on the enterprise network. By inserting a TAP (a Test Access Point, which duplicates network traffic down to the bit level) after the core switch before the firewall / router, and configuring the TAP and OmniEngine based on the servers and ports carrying SAP traffic, network engineers can monitor the quality of service provided by the off-site SAP server farm.

Similar results can be obtained by deploying an OmniEngine in front of the server farm itself. This latter option may be attractive to service providers who want to take advantage of Apdex to monitor the quality of service their SAP applications are delivering.

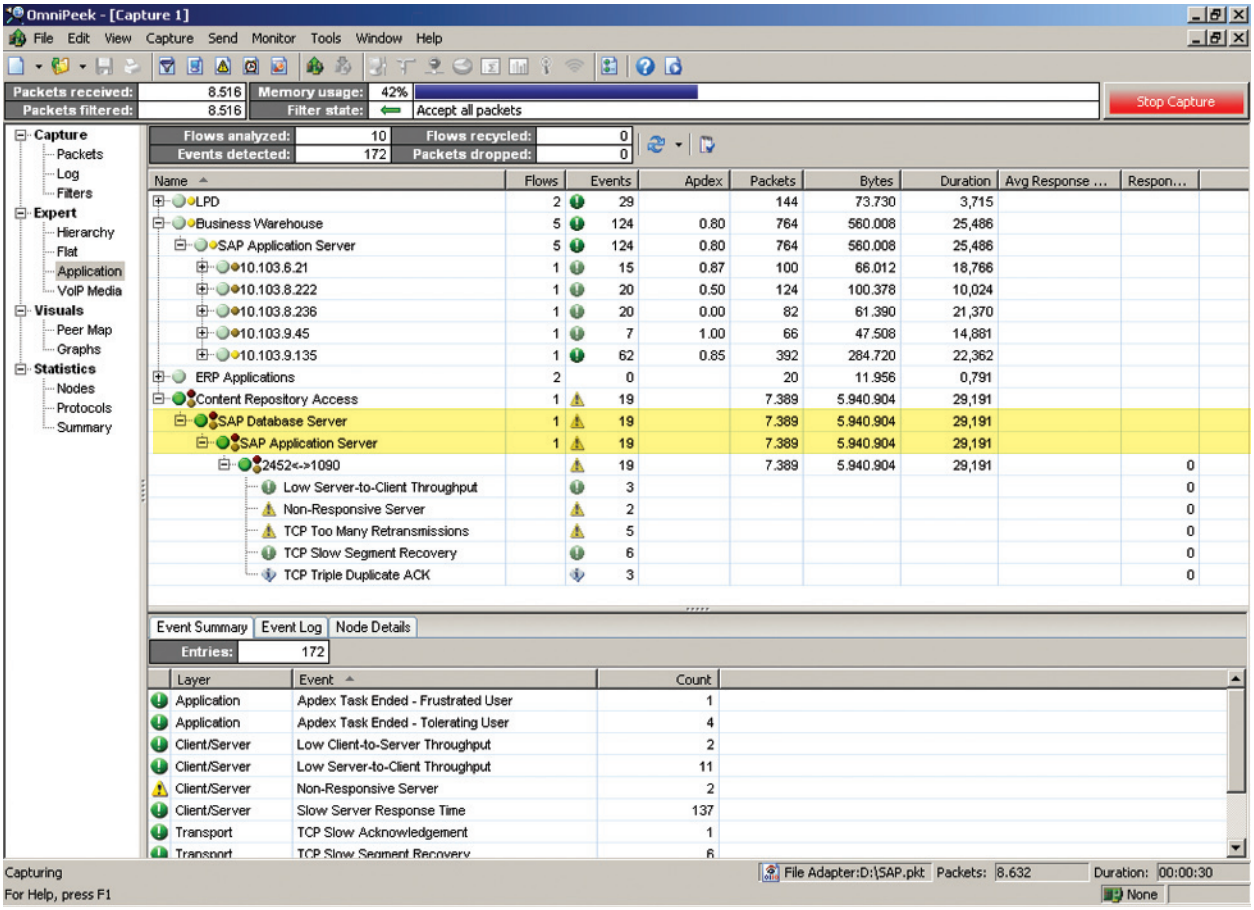
OmniPeek - [Capture 1]
File Edit View Capture Send Monitor Tools Window Help
Packets received: 8,516
Packets filtered: 8,516
Memory usage: 42%
Filter state: Accept all packets
Stop Capture
Capture
Packets
Log
Filters
Expert
Hierarchy
Flat
Application
VoIP Media
Visuals
Peer Map
Graphs
Statistics
Nodes
Protocols
Summary
Flows analyzed: 10
Events detected: 172
Flows recycled: 0
Packets dropped: 0
Name Flows Events Apdex Packets Bytes Duration Avg Response ... Respon...
LPD 2 29 144 73.730 3,715
Business Warehouse 5 124 0.80 764 560.008 25,486
SAP Application Server 5 124 0.80 764 560.008 25,486
10.103.8.21 1 15 0.87 100 66.012 18,766
10.103.8.222 1 20 0.50 124 100.378 10,024
10.103.8.236 1 20 0.00 82 61.390 21,370
10.103.9.45 1 7 1.00 66 47.508 14,881
10.103.9.135 1 62 0.85 392 284.720 22,362
ERP Applications 2 0 20 11.956 0,791
Content Repository Access 1 19 7.389 5.940.904 29,191
SAP Database Server 1 19 7.389 5.940.904 29,191
SAP Application Server 1 19 7.389 5.940.904 29,191
2452<->1090 19 7.389 5.940.904 29,191 0
Low Server-to-Client Throughput 3 0
Non-Responsive Server 2 0
TCP Too Many Retransmissions 5 0
TCP Slow Segment Recovery 6 0
TCP Triple Duplicate ACK 3 0
Event Summary Event Log Node Details
Entries: 172
Layer Event Count
Application Apdex Task Ended - Frustrated User 1
Application Apdex Task Ended - Tolerating User 4
Client/Server Low Client-to-Server Throughput 2
Client/Server Low Server-to-Client Throughput 11
Client/Server Non-Responsive Server 2
Client/Server Slow Server Response Time 137
Transport TCP Slow Acknowledgement 1
Transport TCP Slow Segment Recovery 6
Capturing
For Help, press F1
File Adapter:D:\SAP.pkt Packets: 8,632 Duration: 00:00:30
None

Figure 8. OmniPeek showing problems with SAP flows (above) and listing Expert diagnoses of problems (below)

In the example above, OmniPeek shows highlighted network events that indicate that the SAP Application Server is having difficulty accessing the SAP Database (also known as SAP Content Server). By right-clicking on an individual flow listed under these servers, a network engineer can inspect the actual payload of the affected traffic, using OmniPeek's Visual Expert.

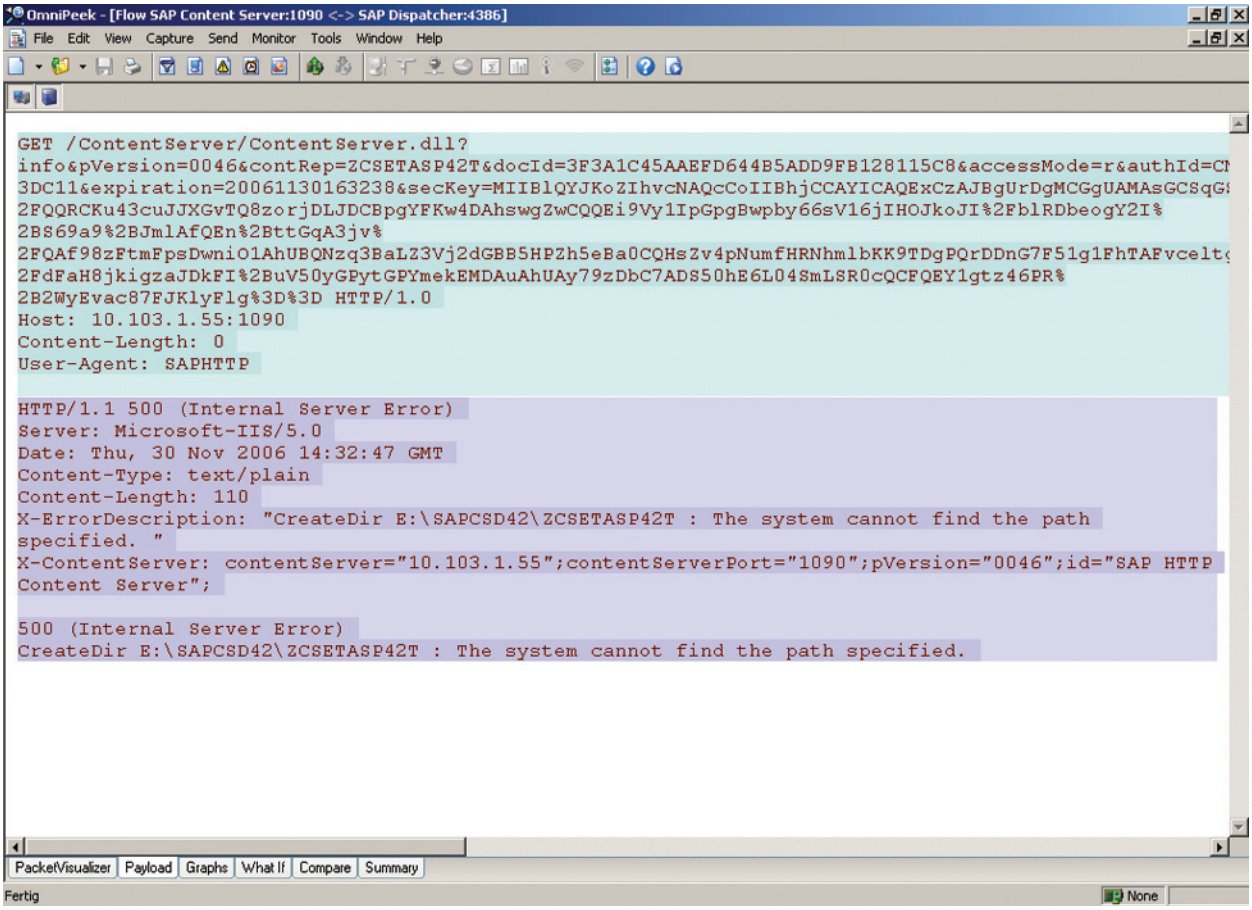

Figure 9. The OmniPeek Packet Visualizer reveals the source of the problem

As this payload shows, a process is trying to create a new directory on the SAP Content Server, and the server is responding with an error message, saying it cannot find the specified path. Now it's up to the SAP Application Administrator to decide what is causing the problem—but in any case, it's not the network!

This example demonstrates the way OmniPeek can help keep an SAP environment (and other IT environments, too) performing optimally.

Monitoring Service between the Application Server and the Database

If problems are experienced but the packets don't clearly identify the source of the problem (Client, Application Server, Network, Database) immediately, an additional analysis behind the SAP Application Server and the Database can become necessary. OmniPeek provides unique features to combine and analyze the information from multiple segments and help to troubleshoot a Multi-Tier Architecture.

A thorough discussion of how to detect other types of problems—such as hardware shortcomings, RAM allocation, application programming errors, "expensive" SQL requests, and database configurations—is beyond the scope of this paper. WildPackets consultants are available for diagnosing network and application problems related to your SAP implementation. For more information about WildPackets consulting services, including the Network Health Check service, please visit www.wildpackets.com/services.

Network Reporting for SAP Applications

Leaving deep packet analysis aside for a moment, a tremendous amount of information can already be gained just by examining the statistical data and comparison tables available through OmniPeek. Historical information is available for the required amount of time. Statistics can either be saved as HTML reports or used to create long term trending information (which is also very useful to answer Network Re-Design Questions or as the beginning point for comprehensive Root Cause Analysis).

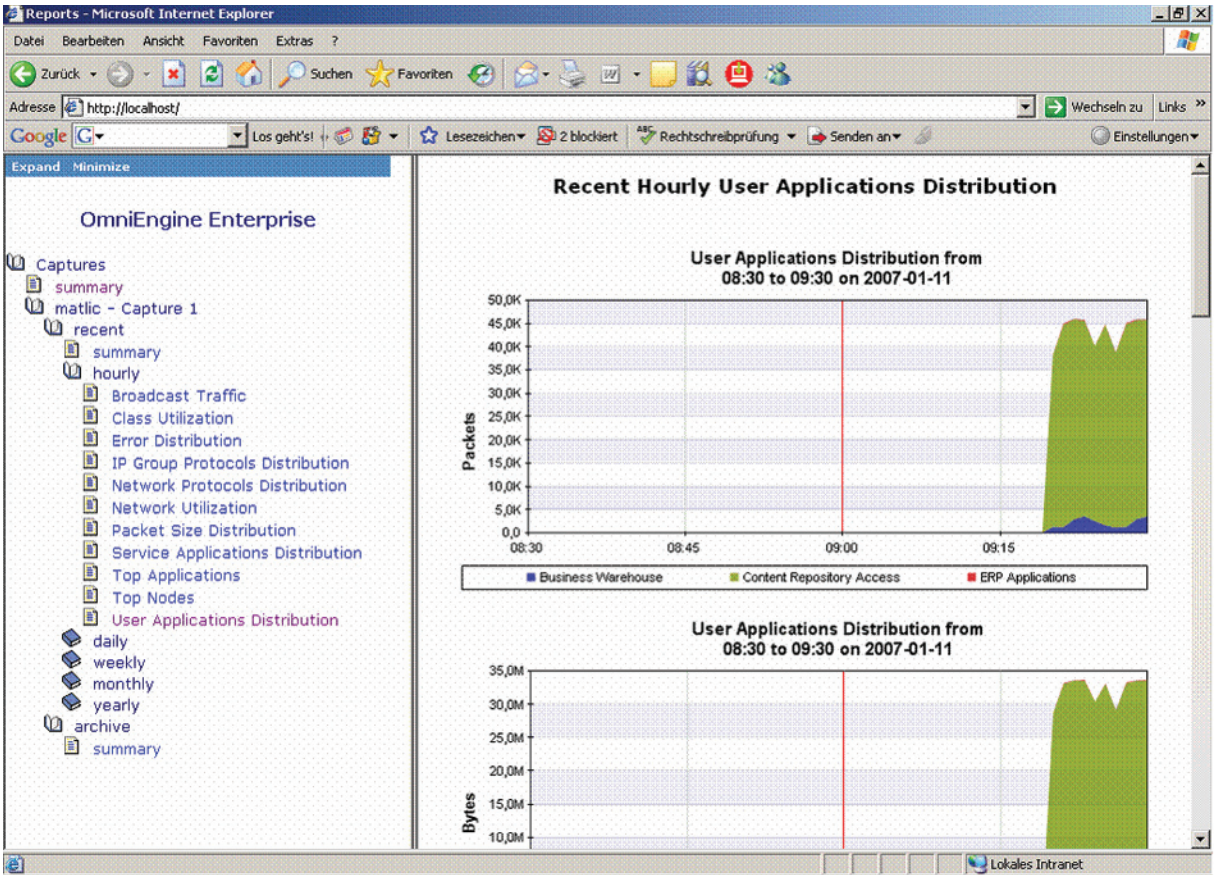

Figure 10. Example of OmniReporting Service for Bandwidth usage of specific Applications

If someone complains about intermittent problems or a performance problem that occurred last weeks, it's possible to use these reports or the network forensics features of the platform to go back in time to identify, characterize, and troubleshoot the problem.

Advantages of the OmniPeek Apdex Solution Compared to Other Performance Management Solutions

Every enterprise network is swimming with metrics available via logs, router statistics, SNMP information, server performance monitoring (CPU, disk I/O, etc.), and so on. What are the advantages of the OmniPeek Apdex solution over these other metrics?

Focus on Users

The Apdex metric measures the most important thing of all: the service that end users are receiving. Other, lower-level metrics, such as server-response time, may suggest that users are or are not receiving a high quality of service. Often, it's too difficult to tell. Server response time might be slow, yet not affecting users. Or it might be fast, but users are suffering because of some other performance problem. By focusing on the quality of service that end users are receiving, OmniPeek keeps troubleshooting and configuration management focused on the end goal.

Ready for Broad Use on Any Enterprise Network

OmniPeek provides out-of-the-box measurement of what's really affecting users, without requiring network engineers to spend hours or days configuring the software for a particular application. Apdex can be used to measure the quality of service for SAP—and for many other applications on your network.

Support for Drill-Down Investigations

When application performance degrades, OmniPeek's Expert Analysis can rapidly diagnose the root causes, whether the causes suggest diagnostics that are applicable for the network support staff (expert events below the application and session layer) or application events that point towards server issues that the database/SAP-Administrator can investigate. Because so many different factors can affect SAP performance, the Expert Analysis and rapid drill-down capability provided by OmniPeek are invaluable for sites running SAP applications.

A Watchful Eye during Configuration Changes

Being independent from a SAP version and the hardware SAP applications are running on, OmniPeek provides an objective measurement of how applications are performing before, during, and after the provisioning or configuration changing of business-critical applications.

Minimal Impact on Devices and the Network Itself

Finally, a performance measurement solution should neither influence the performance of the devices being monitored nor congest the network bandwidth that applications require. OmniPeek has been designed to place only minimal load on the network. OmniEngines analyze traffic locally, so they do not need to send gigabytes of capture files to the console for analysis. Instead, they send only the data needed for presenting analysis results on the OmniPeek console. Typically, communications among OmniPeek components consume as little as 8-10 kb/s on average, producing negligible effect on the network.

Individual and Customer-Specific Enhancements

In addition to monitoring application performance and quality of service, OmniPeek can also monitor important factors such as server availability. The platform's Expert Analysis detects and flags "Non-Responsive Server" conditions. Since clients are continually sending Syn´s to servers, watching for this Expert Event can alert network engineers to a SAP server that is no longer responsive. Of course, network engineers can monitor other business-critical applications this way as well.

Integrating OmniPeek with Other Monitoring Solutions

Since it is an open and extensible monitoring solution, OmniPeek can be enhanced with SAP Application specific plug-ins and integrated into other frameworks like CA's Spectrum, BMC's Patrol, or combined with SAP's own monitoring solution CCMS, just to name a few examples.

For examples of extensions to the OmniPeek Product Family, visit the WildPackets Developer Network Web site at wpdn.wildpackets.com.

To learn more about custom integration projects, please contact your WildPackets representative, or write to our Custom Engineering Group at ceg@wildpackets.com.

Learn More

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